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Change of Address

Please forward changes of address for the News Letter to: Commanding Officer, U. S. Naval Medical School, National Naval Medical Center, Bethesda, Maryland 20014, giving full name, rank, corps, and old and new addresses.

The issuance of this publication approved by the Secretary of the Navy on 28 June 1961.

Current Worldwide Importance of Arboviruses*

William C. Reeves Ph D, Professor of Epidemiology, University of California School of Public Health

Arboviruses constitute an extremely large group of infectious agents. All have the characteristic of infecting vertebrate hosts in which they may or may not produce clinical disease. When they infect these hosts they must produce a viremia, else the hosts cannot serve as sources of vector infection. All of these viruses are biologically transmitted by a blood-sucking arthropod in which they multiply and cause infection. One hundred fifty viruses are now known to be carried by ticks, mites, or mosquitoes; one hundred twenty-eight have been described in detail.

Prior to 1930, only five of the classical viruses were known, including the yellow fever, dengue, and Japanese B encephalitis viruses. During the following decade, eight more were discovered, including those causing Western equine and St. Louis encephalitis. Since then, a fantastic increase has accrued as a result of increased research effort in the tropics.

Antigenetically, arboviruses are a complex group separable into a number of divisions by serologic means. It is particularly important to recognize Group A viruses, such as Western and Eastern equine, and Group B viruses, such as yellow fever and dengue.

Arboviruses have a broad geographic distribution; in all of the land masses in tropical or temperate zones, they are represented. North America, Europe, and Australia, being in the temperate zone, have fewer species than tropical areas where, as with plants and animals, more species develop. A few viruses are found on as many as four continents; man or his domestic animals seem capable of distributing these viruses most rapidly and effectively. Viruses found on only one or two continents have a less efficient means of spread to man and domestic animals; birds and rodents serve as primary hosts.

Forty-nine of these viruses have been isolated from arthropods, but as yet undemonstrated is their relationship to vertebrate hosts. Thirty more related viruses may fall into this group. Ninety-eight of these agents have definitely been shown to be tied in with an arthropod vector, and only thirty have not, as yet, been associated with a vector. Seventy-nine have been isolated in vertebrates; forty-nine others have not been isolated from a vertebrate host, but there is serologic evidence to indicate that they do

* This is the eleventh paper from the Tropical Medicine Symposium, USNH Oakland, Calif., March 14 and 15, 1963. The preceding papers were published in the Medical News Letters of 15 November and 6 December 1963, and 3 January 1964. Edited by Captain Arthur J. Draper MC USN; authorized by the CO of the Hospital, Rear Admiral Cecil L. Andrews MC USN.

affect vertebrates. Forty-eight of these viruses have been isolated from human beings in whom clinical disease of some type was present. In addition, twenty-eight have been shown by serologic means to stimulate the production of antibodies in man. Still others under study have either experimentally or accidentally infected man under laboratory conditions.

In man, arboviruses produce a broad range of clinical syndromes. Some are generalized, fever, malaise, headache, and pain; these include Mayaro and O'nyong nyong infections of the tropics, relatively mild disorders, as well as dengue types 1 and 2. The newer dengue types 3 and 4 cause a hemorrhagic type of disease. Classical encephalitides result from infection with Western equine or Japanese B viruses. Some types affect certain organs, such as yellow fever or Rift Valley fever. A number of other diseases produced are not yet really characterized. To stress the worldwide importance of arboviruses, a world tour will now be conducted! Epidemics which have occurred within the past two years will be the primary concern.

In the St. Petersburg-Tampa area of the United States during 1962, there was an extensive epidemic of St. Louis encephalitis. Over five hundred people, mostly elderly, became ill; 158 cases were confirmed by laboratory tests. Seventeen deaths occurred. Fortunately, the epidemic halted before November 1962 when thousands of troops were ordered into the area in association with the Cuban crisis.

An outbreak of Eastern equine encephalitis is going on in Jamaica at this time (March 1963). There have been 11 human cases and 9 deaths. At least 70 horses have died. Very likely Cuba is having a similar outbreak. It is rumored that dengue is also epidemic in Cuba.

Venezuelan equine encephalitis has been reported extensively for several years in Panama. This has not been primarily a horse disease; over 350 human cases have been observed. The disease is characterized by a severe febrile reaction with a fair mortality rate. Protection of troops in the area has been a major concern. Also, in Panama, an outbreak of Eastern equine encephalitis has been reported, with no human cases thus far.

An interesting and troublesome problem has presented itself in Colombia. At first report, thousands of cases of a disease of unknown cause were observed. Investigation revealed the disease to be Venezuelan equine encephalitis. Between six and seven thousand people have been affected, over one hundred of whom died. Concomitantly, an extensive horse outbreak took place with many deaths. In another area of Colombia, a similar outbreak occurred from which a new unidentified virus was isolated, both from man and mosquitoes. Yellow fever, too, is rumored to have been found up river from Barranquilla. A type of hemorrhagic fever has been observed in Bolivia, involving over one hundred cases and associated with a mortality rate of 40% to 50%. The disease is most likely a northward extension of the epidemic hemorrhagic fever, mite-borne, of Argentina, which in that country has lately produced two or three thousand cases with a 25% mortality.

O'nyong nyong, meaning "something new," is the name given by the natives of Uganda in the interior of Africa to what is, indeed, a new disease

caused by a new virus. It has caused over two million cases of mild febrile illness with a low mortality rate. The virus is the first of its type to have as its vector an Anopheles mosquito. There is no natural barrier to prevent the spread of this disease into other areas of Africa. In Ethiopia, the largest yellow fever epidemic of modern times has been raging. In the absence of a census or medical service, the incidence or mortality rate of this epidemic will never be known.

From South Africa, via Egypt and Turkey, African horse sickness has spread into India and Pakistan. Killing more than fifty thousand horses, the disease threatens the agricultural economy of the area. The Indian cavalry—an important part of the armed forces—has been threatened with extinction. An effective vaccine has been developed.

In the Mysore State in central India, a new disease was recognized in 1957. Initially thought to be yellow fever, never before described in Asia, the disease turned out to be tick-borne Russian spring-summer encephalitis. Locally, it is known as Kyasanur, "forest disease." It causes a highly fatal disease in monkeys; hundreds of human cases, too, have shown a high mortality rate. Recently, it has been discovered to be extending; an associated virus occurs in Malaya.

Finally, there are the hemorrhagic fevers which are discussed elsewhere in this symposium. They have occurred in the Philippines, Malaya, and Bangkok. During the past year, four thousand cases have been reported from Bangkok alone, probably half those which actually occurred. Mortality rate was 5%.

Clearly, the arthropod-borne viruses are capable of producing extensive epidemics. Besides the diseases mentioned, dengue fever and Japanese B encephalitis pose major problems throughout the Asian mainland and the adjacent island complexes. Tick-borne viruses are scattered throughout Europe and Russia, and mosquito-borne viruses are well known in North and South America.

The infection cycle of these viruses is very complex. Basically, they all have a vertebrate host; mosquitoes or other arthropods serve as vectors for their transmission to other vertebrate hosts. Some of the agents can go directly from one vertebrate host to another by way of milk, feces, or other such avenues. The problem is to discover what portion of this type of infection chain is essential to maintain the virus in its natural cycle so that there may be a possibility of interrupting it. Then, too, a means may be devised to protect man from accidental tangential exposure in instances in which man is an accidental host not essential to the perpetuation of the virus.

Prevention of human illness from this group of viruses is really quite limited at present. Knocking out the mosquito vector would interrupt the basic infection cycle and prevent perpetuation of virus transmission for some representatives, but this has not been done successfully in some areas, even in the case of Aedes aegypti, a domestic mosquito. Eradication of even this one insect is an extremely expensive process. Application of insecticides to vast jungle areas in an effort to control, say, sylvatic yellow fever, is manifestly impossible. In combat operations, control measures are directed toward

mosquito repellents, protective clothing, and adequate housing. Strict discipline is needed to enforce such measures. Vaccination, save in the case of yellow fever, is largely ineffective. Extensive research is being conducted to develop vaccines against dengue viruses and Japanese B as well as other encephalitis viruses. Especially desirable would be a good living attenuated agent which would confer protection for many years.

* * * * *

Laboratory Methods for Diagnosis
of Parasitic Infection

Quentin M. Geiman Ph D, Professor of Preventive Medicine, Stanford University School of Medicine.

This presentation reviews a parade of parasites and takes up some problems in the diagnosis of parasitic infection. A few general remarks are in order. First, the physician has the responsibility of supervising laboratory technicians who make the diagnosis. Also, he should make sure that specimens are properly collected and delivered to the laboratory. Findings upon repeated examinations and interpretation of results are as good as the laboratory personnel who perform them. Finally, another point to be emphasized is the necessity of follow-up after diagnosis and treatment. Parasites, especially intestinal parasites, may multiply and return. Examination of specimens taken 3 to 4 weeks after cessation of treatment is necessary to exclude such a recurrence.

The parade of parasites consisted of numbered slides and parenthetical remarks by Dr. Geiman. Stool specimens are necessary to detect amebiasis, especially in patients in the tropics upon whom surgical procedures are contemplated. Giardia infection may produce extensive diarrhea but is never bloody. Balantidial infection may also be detected in the stool. Coccidiosis is rare. Trichomonas vaginalis may be recovered from cases with vaginitis; the infection may also occur in the male, in which event, examination of the prostatic fluid will reveal the organism. Also, there are the intestinal helminths, particularly Fasciolopsis and the tapeworms. Taenia saginata is not uncommon in California since many people like rare steak, but T. solium does not occur there. The broad of fish tapeworm can occur, although it is of lesser importance. The pinworm is universal, commonly diagnosed by the use of the NIH swab. Once a child brings home the infection, the whole family usually get it; the family—not just the first child—must be treated. Strongyloides infection can produce an extensive diarrhea; it occurs in California and is common in the tropics. Trichinosis and visceral larva migrans lead to the tissue helminths. Visceral larva migrans—much studied of late—represents infection by dog or cat nematodes which are responsible for a certain percentage of tropical eosinophilia. Diagnosis is usually difficult. Cystocercosis results from tissue infestation with larvae of the intestinal parasite Taenia

solium, the pork tapeworm. Filariasis has been discussed at length elsewhere in this symposium.

Malaria results from a blood parasite. Dr. Thompson discussed the preparation of thin and thick smears for detection of these organisms. Thick smears (which must be properly prepared on the slide or it will appear as though the patient had had a hemorrhage) are useful for diagnosing trypanosomiasis, relapsing fever, and even toxoplasmosis.

Leishmaniasis may be diagnosed from study of the blood, biopsy of the spleen, blood culture, marrow culture, and from cutaneous lesions. Cutaneous leishmaniasis may cause scarring of the nose and face. In South America, mucocutaneous infection may destroy the nasal septum. A serologic test commonly used in Central America, the Montenegro reaction, is 95% to 98% valid in determining cutaneous leishmaniasis, but ineffective for the purpose in visceral forms. The differential diagnosis of the skin lesion may be difficult. Occurrence in an endemic area will alert the examiner, but the appearance of the lesion resembles spirochetal infection, cutaneous diphtheria, or fungus infection, especially if it does not have the indurated margin which usually characterizes leishmaniasis. Yaws, syphilis, or tropical ulcer must also be considered. For diagnosis, material must be taken, not from the base, but from the margin of the ulcer where parasites are usually found. Skin lesions are for the most part on the exposed parts of the body where biting sandflies take their blood meal.

Toxoplasmosis, extensively studied recently, is a sort of parasite in itself, Toxoplasma gondii. The organisms appear, beside leukocytes, as small crescentic shapes. At times, they appear in clusters as in sections of the human heart. One test for the presence of toxoplasmosis is the Sabin-Feldman dye test; animal inoculation is also successful.

In the more bizarre types of blood-stream infections, such as sleeping sickness, blood studies, lymph node aspiration, and spinal tap are helpful approaches to diagnosis. Chagas' disease (American trypanosomiasis), common throughout Central and South America, shows a question mark shape in thin or thick blood films. Tissue stages of the disease closely resemble leishmaniasis. Another method of study is to feed noninfected triatomid bugs, the vectors, on the patient and see if trypanosomes grow out.

Schistosomiasis is a major medical problem throughout the world. Some 2500 cases occurred during the invasion of Leyte Gulf during World War II. A blood fluke is the responsible organism. Eggs of the parasite should be sought in the stool or urine of the affected patient. Serologic methods of diagnosis are being tried; work is being done with fluorescent antibodies. Field tests are being carried out in Africa with an antigen against Schistosoma mansoni.

Among liver flukes are included clonorchiasis and hydatid disease which may also involve the lung. Enormous numbers of daughter cysts may occur in a liver containing a parent cyst. Material from daughter cysts may show the scolices and hooklets of the scolices. A serologic test for hydatid disease gave a definite positive reaction in one case at Stanford.

Clonorchiasis

Walter G. Strauss MD, Assistant Clinical Professor of Medicine,
University of California Medical Center.

Clonorchiasis, infection with the Chinese liver fluke, endemic in large areas of the Orient, is transmitted only in that area. It is found, of course, in patients outside the endemic; viz., the San Francisco Bay Area where it is the most common tropical disease. In San Francisco in 1901, it was first discovered in the course of autopsy studies on Chinese who had died of plague. For a time thereafter, health regulations excluded from the United States those Chinese who showed clonorchis in the stool. No reservoirs or animal hosts for the organism have been demonstrated in the United States.

Clonorchis sinensis is a platyhelminth, flatworm, 15 mm long and 3 mm wide. Anteriorly, there is a small sucker which opens shortly into a pharyngeal pouch, esophagus, then fiburcates into a paired intestine which ends blindly. The animal regurgitates the products of digestion out of the oral sucker. A second sucker is directly connected with the genitalia. The branched genital structures give the animal its name—"clonorchis" means "convulated testes."

The adult organism lives in the bile ducts of man or the reservoir hosts; infection may consist of a very few or a great number of organisms. The eggs are passed through the bile ducts, mingle with the intestinal contents, and fall into fresh water with the stool. Intermediate stages develop in snails and then in fish belonging to the carp family. Man becomes infected by eating raw carp. This cycle reaches completion only in China, Japan, Korea, and Formosa.

During the late 1930's, many refugees from Nazi tyranny fled to Shanghai. Accustomed in Germany to eating Bismarck herring, these people relished the Chinese fresh water carp which were heavily contaminated with clonorchis. Immigration of about 1200 German refugees from Shanghai into San Francisco has afforded the author an opportunity to pursue comparative studies of clonorchiasis as manifested in this group and in Chinese in San Francisco. About 40% of the first group have been found by stool examination to be infected; the author estimates that about 16% of Chinese individuals out of the 36,000 living in the Bay Area are infected. A considerable number of European Russians, and a few Koreans in the area are also infected. The Japanese, of whom some 7000 live in the Bay Area, are not infected, nor have members of the U.S. Armed Forces been found to be infected.

With respect to symptomatology of the disease, the medical literature is confusing. Meyer, in Germany, for instance, found it harmless among Chinese merchant seamen in Hamburg. Berkowitz, by contrast, described in Americans a disease with high mortality. Clinical observations made by other writers have varied widely.

The author subjected the clinical data amassed from 105 cases to meticulous analysis. Forty-eight Caucasians seemed to have a high incidence of

abdominal complaints as contrasted with the rarely symptomatic Orientals. Weight of infection as judged by the number of eggs per gram of stool was not an explanation. Statistical analysis showed no difference in occurrence of symptoms in infected Caucasians as compared with uninfected Caucasians, nor was there a difference between Orientals with and those without Clonorchis. Symptoms ascribed to clonorchiasis in the past, then, appear to be more a function of the ethnic group infected than of the presence of infection. The author concludes that ordinarily there is no symptom-complex or group of findings which can be called "clonorchiasis."

* * * * *

Infection Control in Tropical Surgery

Charles B. Beal MD, Instructor in Preventive Medicine, Stanford University School of Medicine.

Hazards in diagnosis and management confronting the surgeon, and hazards of infection or cross-infection facing the patient in tropical areas form the substance of this presentation.

Amebiasis, ascariasis, and malaria may be considered three tropical diseases which present difficult problems in diagnosis and management. The protean manifestations of amebiasis may involve the bowel, liver, pulmonary system, genital tract, central nervous system, and the skin. Ameboma may mimic carcinoma of the large bowel. Amebic infection of the cervix has been mistaken for advanced malignancy. An infection of the cecum commonly presents like appendicitis. Enlarged tender liver, without jaundice and with very little derangement of liver function tests, may represent amebic hepatitis rather than viral hepatitis. If liver abscess develops, the first requisite for diagnosis is the knowledge that it might be amebic in origin. Since trophozoites—more often than not—do not appear in the stool, a trial of emetine or chloroquine, or judicious aspiration may clarify the problem.

Ascariasis may present a difficult problem in diagnosis, especially in terms of obstruction, and particularly in children. A palpable mass suggests intussusception which, indeed, may accompany ascariasis of the bowel. A bolus of ascarids in the ileum has a doughy or crepitant feel which is almost pathognomonic. A history of the passing of ascarid in the stool, or the demonstration of ova on a fingercot specimen aid in diagnosis. X-ray examination, especially with barium, may show a "wound-up ball of string" picture. Management is best carried out by intestinal intubation for decompression; piperazine (Antepar) through the tube should be administered. Abdominal massage is dangerous. Laparotomy, necessary at times, gives an opportunity to milk the worms through the ileum to the cecum or to remove them one by one from the opened bowel. Closure must be accomplished in healthy tissue or any worms left will migrate into the peritoneal cavity or right out through the surgical wound!

Since malaria tends to relapse after stress, operation, childbirth or injury, it is most often a complication but may pose a diagnostic problem in the postoperative or postpartum state. Falciparum, or malignant tertian malaria, may cause acute abdominal pain.

Infection acquired by the patient in the hospital—everywhere a problem—in the tropics is an extremely formidable adversary of the surgeon. First, the skin of the patient himself may be contaminated with staphylococcus. In a hospital in Central America, for example, a high incidence of breast abscess in mothers was found attributable to the fact that 99% of infants were colonized by the third hospital day with resistant staphylococcus. Phisohex (cleansing) for the babies appeared successful in controlling the problem. Also, wounds that contain a great deal of necrotic tissue and hematoma, especially if contaminated, are likely to become infected. Where filariasis is endemic, 50% of surgical wounds chronically drain. In the presence of elephantiasis, the skin is very hard to clean and hemostasis is difficult. Surgical drains result in a 100% infection rate. Organisms other than staphylococcus, of course, may cause wound infection, viz., streptococci, diphtheriae and clostridia.

In the attempt to meet the problem of infection, the design of the hospital itself must be considered. The classical European style colonial building, by contrast with temperate zone hospitals with central quarters and nursing stations, has quarters which open to the outside. Advantages of this design are that patients get any available breeze and the air blowing in is confined to the individual room rather than blowing throughout a large central ward. The chief disadvantage is a loss of nursing efficiency. Vigilance must be exercised to see that nursing technics do not become careless.

Other problems, more pressing in tropical areas than elsewhere, are fly control, blood transfusion, and anesthesia. Many agents produce contagion in blood transfusion. Although malaria and syphilis are no longer major considerations, viral hepatitis is a grave possibility. In Nigeria, for example, 5% of blood transfusions produce hepatitis; the mortality rate in patients over age 40 from homologous serum hepatitis is 22%.

In the struggle against flies and infection, the author has devised a method of isolating the operative area by means of a plastic bag attached to the patient with sterile glue. The bag, inflated with filtered sterile air, contains adjustable armlets through which the surgeon thrusts his arm; he may work with entirely satisfactory visibility with surgical instruments which have been placed in the sterilized area within the bag. Examples of the use of this procedure in repair of inguinal hernia, lobectomy for pulmonary tuberculosis, several orthopedic operations, and one mastectomy were shown on slides. A similar technic is helpful in protecting the wound during the postoperative period.

FAINTING*

Juergen E. Thomas MD and E. Douglas Rooke MD, Section of Neurology, Mayo Clinic, Rochester, Minn. Proceedings of the Staff Meetings of The Mayo Clinic 38(19), September 11, 1963.

A list of the main conditions with clinical features that can be confused with syncope might include epilepsy, vertigo, hyperventilation, hysteria, and migraine. Episodic cerebrovascular insufficiency may sometimes need to be considered. This condition has already been discussed in a previous section. Narcolepsy, cataplexy, hypoglycemia, and tetany are occasionally mentioned in the differential diagnosis of syncope, but in almost every instance a careful history will reveal obvious points of distinction.

Epilepsy. In evaluation of "spells" the most frequent uncertainty is the distinction between syncopal and convulsive mechanisms; indeed, there are times when the history alone will permit no clear choice, especially when only a few episodes have occurred. For the most part, however, the distinction can be made with the following points in mind:

Speed of Onset. Most syncopal attacks feature a brief period of warning before consciousness is lost—a fading or graying of vision, squeamishness in the stomach, cold perspiration, and weakness in the legs. One must distinguish these complaints from the aura of a convulsive state, and one of the most obvious differences is the favorable influence of recumbency in syncope.

Many convulsive episodes begin abruptly without warning of any kind. Even when there is an aura, it is usually a consistently repetitive chain of events more often sensory than motor, and with the possible exception of the rising epigastric aura of temporal lobe epilepsy, the premonitory experiences have little in common with the symptoms of syncope.

An abrupt onset without warning of any kind does not entirely exclude the diagnosis of syncope since cardiac conditions (for example, Morgagni-Adams-Stokes syndrome) can manifest themselves in just this way. The great majority of such sudden episodes, however, prove to be convulsive in nature.

Consistency of Pattern. This is a characteristic of epilepsy but not of syncope. Once the chain of events is initiated in epilepsy, it tends to run its identical course on each occasion, and the duration of each separate episode is also quite consistent. A syncopal spell, on the other hand, may be modified by prompt remedial measures (especially recumbency), and different episodes may vary greatly in length depending on how rapidly these measures are taken or how quickly an underlying cardiac dysrhythmia improves.

* Concluded from the Medical News Letter, Vol. 43, No. 2, 24 January 1964.

Postural Influence. Except for cardiac syncope, a rare disturbance that can occur with the patient in any position, syncopal episodes occur with the patient upright, usually standing but sometimes sitting. A clinical history in which spells have never occurred during recumbency or sleep would favor the diagnosis of syncope over that of epilepsy.

Motor Phenomena. Convulsive movements are not confined to the epileptic state, and after the loss of consciousness in severe syncope, spasms, twitching, and mild convulsive movements can be seen.

Skin Changes. These may also be helpful since syncope is usually featured by marked pallor, often with cold perspiration. An occasional patient in an akinetic epileptic state may also appear pale, but for the most part, flushing or cyanosis with warm perspiration during a spell is much more characteristic of the convulsive state and is not seen in syncope.

Sphincter Incontinence and Tongue Biting. These are certainly "convulsive" features, but urinary incontinence has been seen in particularly severe syncope, and it is possible for a patient to faint so abruptly that the tongue can be injured in his fall.

Recovery. Recovery from a faint is usually rapid with prompt orientation, rarely any headache, and no amnesia. The spell is vividly recalled, sometimes even including audible events that occurred after the patient appeared to be unconscious. In syncope, physical weakness and fatigue outlast the disturbance in consciousness and the patient prefers to remain inactive after regaining consciousness.

Following a convulsive episode, on the other hand, varying degrees of bewilderment are frequently seen and headache is common. The patient is often able to be up and moving about for several minutes before his mind clears completely and he may then prefer to sleep for an hour or so.

In spite of all these distinctive features, spells will still be described about which a definite decision cannot be made. In these instances, the electroencephalogram may sometimes be helpful. However, a normal interval record does not exclude epilepsy any more than a moderate dysrhythmia in the brain waves excludes the possibility of a syncopal mechanism.

Vertigo. Vertigo will seldom be confused with syncope if the patient can be induced to describe exactly what he experiences. In this condition, there is a sense of movement either in the environment or of the patient himself. Falling may be abrupt and violent, but consciousness is not lost. Nausea is frequent and the associated pallor and cold sweat may sometimes suggest fainting to an unwary observer. The increased distress with head movement is quite characteristic of vertigo and seldom seen in syncope.

Hyperventilation. This phenomenon may complicate several different conditions including syncope itself. It is usually a manifestation of an emotional disturbance and when repetitively recurring can pose a diagnostic problem. The sensation of needing more air, with resultant deep and rapid breathing, may not be described spontaneously by the patient and needs

specific inquiry by the examiner. Symptoms of faintness, lightheadedness, paresthesias of the fingers, lips, and toes bilaterally should stimulate such an inquiry. Hyperventilation spells may constitute the whole problem in themselves, but they may also be secondary reactions to a true syncopal attack and these two conditions are not mutually exclusive.

Hysteria. This condition can usually be distinguished from syncope by the calm detachment with which the patient describes her symptoms, the vagueness of description, the absence of pallor and sweating as described by others, and the almost invariable presence of an audience. These episodes are not dependent on the upright position and do not respond so promptly to recumbency. Hyperventilation may also be part of the picture. The patient is likely to be either a naive unsophisticated young person or an older one in whom a previous conversion tendency can be established. Hysteria is not entirely confined to females, but occurs much more frequently in them than in males. One should always be skeptical about "hysteria" that appears unheralded in middle age or later. It may prove to be something else.

Migraine. Attacks of migraine ordinarily have no syncopal features, but Bickerstaff (25, 26) and Selby and Lance (27) have drawn attention to a rare situation in which the basilar arterial system may be involved in addition to or instead of the more commonly affected carotid system. In these patients, usually adolescent girls, the premonitory aura of a migrainous episode terminates in deep unconsciousness of several minutes' duration, followed by severe headache typically occipital in location.

Conclusion

Among the disorders of consciousness, syncope is probably the least alarming and the most benign of all. Its manifestations are characteristically protean and tend to vary in intensity, duration, and character from one attack to the other. With a few exceptions, autonomic features such as pallor, nausea, and perspiration are prominent and may precede and outlast the spell for some time. The faint occurs almost always while the patient is upright, its onset is probably never as instantaneous and the level of consciousness is not as profoundly depressed as in an epileptic seizure. Minor convulsive twitching of the face and extremities can occur, but usually lasts only a matter of seconds and does not pursue the sequence of a grand mal attack. Oftentimes, the syncopal spell can be alleviated by quick assumption of the recumbent position.

Vasodepressor syncope outranks all others in frequency of occurrence. In contrast, syncope caused by orthostatic hypotension, primary and reflex cardiac disorders, coughing, and cerebrovascular disease is rare. None of the clinical manifestations comprising the syncopal syndrome is sufficiently distinctive to provide conclusive evidence of the underlying cause. However, in many instances, valuable information can be gained from a careful analysis of such factors as age of the patient, the position of the body at the time

of the faint, the duration as well as the manner of onset of and recovery from the spell, and the associated symptoms and signs.

Syncope occurring in the young person is predominantly of vasodepressor type. Rare other causes at this age are congenital cardiac anomalies, valvular heart disease and paroxysmal tachycardia. In later adult life, vasodepressor syncope occurs less frequently and organic conditions, such as intrinsic heart disease, orthostatic hypotension, carotid sinus hypersensitivity, and cerebrovascular disorders, are more common.

Presyncopal symptoms are often pronounced and prolonged in the ordinary vasodepressor faint, while sudden loss of consciousness without warning may occur in primary or reflex cardiac asystole and in severe orthostatic hypotension. The latter is also the likely offender when syncope follows assumption of the upright position. The occasional faint affecting the recumbent patient is probably due to prolonged cardiac asystole. Loss of consciousness related to exertional activity suggests as the cause aortic stenosis, coronary heart disease, primary pulmonary hypertension, orthostatic hypotension, congenital cardiac anomalies, or the aortic arch syndrome. Bradycardia of less than 40 beats per minute points to a complete heart block; and tachycardia of more than 150 beats per minute implies an ectopic cardiac rhythm.

Since only rarely can the physician witness a spontaneous attack, recognition of the syncopal nature of the spell and its differential diagnostic separation from other conditions often depends entirely on the history. In final analysis, it should be remembered that the total picture of the attack is often more important than the presence or absence of any isolated symptom.

If general physical and neurologic examinations fail to reveal the cause of the syncope, attempts should be made to reproduce an attack by provocative maneuvers, such as carotid sinus stimulation, postural changes of the body, and voluntary hyperventilation. However, positive results of such tests can be considered diagnostic only when they produce symptoms identical to those experienced in the spontaneous attack. Abnormalities in the electrocardiogram will raise the physician's index of suspicion, but do not necessarily establish a diagnosis of cardiac syncope. Similarly, a normal electrocardiogram does not exclude a cardiac etiology. An electroencephalogram may aid in differentiating seizure from syncope, and if obtained during a provocative test, may permit recognition of hysterical "fainting spells."

Syncope, for the most part, is a benign and transitory condition. However, it may occasionally indicate the presence of a serious organic disorder. For this reason, repetitive syncopal episodes should alert the physician and lead to a careful and systematic search for such underlying disease.

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SUBMARINE MEDICINE SECTION



BASIC PHYSIOLOGY IN SCUBA AND SKIN DIVING*

Karl E. Schaefer, M.D., Head, Physiology Branch, Medical Research Laboratory, U. S. N. Submarine Base, New London, Connecticut

Pulmonary Gas Exchange During Breathhold Dives

During the training of submarine crews in submarine escape procedures, such as "free or buoyant ascent," instructors at the escape training tank frequently hold their breath under water and perform "skin" dives to depths as great as 90 feet. The ascent is carried out by climbing up a line. These diving maneuvers are similar to those practiced by sponge and pearl divers. The escape training tank at the New London Submarine Base afforded us an opportunity to study the pulmonary gas exchange during this type of diving.

Prior to the descent the diver exhaled to residual volume and then inhaled 4 liters from a spirometer. After reaching a predetermined stopping point during diving, he exhaled the major part of his expiratory volume through a mouthpiece into the first bag used for the collection of mixed expired air; he exhaled the remainder into a second bag used to collect "alveolar air." (The latter usually contained 10 to 20 percent of the total expiratory volume.) The bags were brought to the surface. Gas samples from the bags were collected and analyzed and the volumes measured. The CO_2 and O_2 content in the lungs at various depths was calculated from the measured gas tensions and volumes of mixed expired and alveolar air, and the total dry gas pressure in the lungs.

Due to the increase in pressure the CO_2 tension in the lungs rose quickly above the venous CO_2 tension and a reversed CO_2 gradient developed. At 90 feet approximately 50 percent of the pre-dive CO_2 content of the lungs had disappeared and was taken up by the blood and tissues. The influx of carbon dioxide into the lungs during ascent appeared to be rather slow and it was found possible to control the alveolar CO_2 level by the speed of ascent. If the ascent was fast the alveolar CO_2 tension attained on reaching the surface was low, between 30 & 35 mm. Hg; if the ascent was slow, the alveolar CO_2 tension rose to 40-45 mm. Hg. The alveolar oxygen tension rose from control levels of 100 mm. Hg to 300 mm. Hg at 90 feet depth and fell on ascent rapidly during the last 10 feet to such low values as 25-30 mm. Hg.

The disappearance of CO_2 from the lungs during dives together with the oxygen utilization and mechanical compression of the thorax as the subject descends produce a progressive shrinkage of the total chest volume. These factors may explain the observation reported by Behnke that subjects holding their breath under water increase in weight and are less buoyant.

It is reassuring to know that a diver at 90 feet is somewhat protected inasmuch as the CO_2 tension does not rise to dangerous levels and the oxygen tension is rather high. Under these conditions, breath-holding time is considerably prolonged. However, during the last part of ascent or just at the moment the diver reaches the surface, available oxygen may become so depleted as to produce anoxia. The alveolar oxygen falls to a very low level at the end of ascent from dives to 90 feet. We saw one instructor becoming confused in the moment he gave the alveolar sample after reaching the surface, but he quickly recovered after the first breath. His alveolar O_2 concentration was 3.5 per cent (pO_2 alv. 28 mm. Hg). With a very low oxygen content and a normal or below normal CO_2 concentration, the nitrogen content of the alveolar air at the end of the dive is markedly increased, 89 per cent compared with a normal 79 per cent.

Measurements of blood gases, lactic acid, respiration and metabolism made on four subjects before and after diving to 90 feet produced the following results: The CO_2 content of blood rose very slightly while the oxygen content fell during the dive. The lactic acid content in the blood increased about 5-fold during the dive. In this case a sample was taken one minute after the dive. The lactic acid decreased to a level slightly above normal within five minutes. On more frequently collected venous samples, peak lactic acid concentrations were also measured after three minutes of recovery following the dive. The one minute values were consistently lower than the three minute values. This corresponds with findings recently obtained by Scholander in pearl divers. The delayed but large rise in lactic acid found during the recovery phase in man is quite similar to that observed in the seal and might according to Scholander also be interpreted as an indication of reduced muscle blood flow during the dive.

Respiration was increased 3-fold during the first minute after the dive and returned to normal level within 15 minutes. The excess oxygen uptake above the control level after the dive was limited to four minutes and averaged 1400 cc. in four subjects. This indicates that the oxygen debt taken during the dive of 1-1/2 minutes is in the order of 1400 cc. The excess CO_2 exhalation within the first four minutes after diving averaged 900 cc.

Scholander also noted a marked diving bradycardia during active diving. The pulse rate was reduced to one-half of the pre-dive value, while breath-holding at the surface leads to a much smaller decrease in pulse rate. Extra systoles were noted in ECG tracings during the dive and arrhythmias and atrial fibrillation during the recovery phase. Blood pressure measurements made after breathholding under water and in air did not show significant changes in systolic and diastolic pressures.

Adaptation To Diving

The breathholding time of tank instructors was found to be 105 seconds, while that of a group of laboratory personnel was 60 seconds. The vital capacity of 16 tank instructors was not only significantly larger than that of the group of 16 laboratory personnel, but it was also 20 per cent higher than could be predicted by their height, weight, and age, using the West formula. Total lung capacity, tidal volume, vital capacity and respiratory reserve were markedly increased in the tank instructor group as compared with the laboratory personnel. To decide whether the lung volumes really change during the course of duty at the tank, a longitudinal study was carried out and the lung volumes of tank instructors measured at the beginning of their tour of duty and after one year. Respiratory reserve, tidal volume, vital capacity, and

total capacity showed a significant increase while residual capacity decreased. The maximum average depth a diver can reach without getting a thoracic squeeze depends on the ratio of total lung capacity to residual capacity and the volume of the airways. The observed change in this ratio results in a 20-30 foot extension in the maximum safe depth after one year of duty.

The ventilatory response to increased concentration of CO_2 and to a lowered concentration of O_2 (10.5 per cent) was found significantly decreased in instructors at the escape training tank as compared with the laboratory personnel. The CO_2 tolerance curves were obtained by exposing subjects for 15 minutes to 3.3, 5.4 and 7.5 per cent CO_2 . Alveolar ventilation and alveolar gas CO_2 tensions were determined at the end of the exposure period. The stimulus response curves (or tolerance curves) to CO_2 showed, in the case of the tank instructors, a shift to the right and a decreased slope. The high tolerance to CO_2 is developed during the diving period and lost after a three-month lay-off period as shown in CO_2 sensitivity tests in eight tank instructors.

Blood gas and electrolyte changes observed at the end of a longer period of water work were similar to those noted during adaptation to prolonged exposure to CO_2 . They consisted in a decrease in pH, increase in pCO_2 and bicarbonate levels commensurate with an increase in hematocrit and red cell cation exchange, e.g., increase in red cell sodium and decrease in red cell potassium. These adaptive changes disappeared after a three-month layoff period. Furthermore, evidence of an increase in CO_2 stores, as the result of diving, was obtained in instructors following a two-year period of water work when compared with data obtained after a three-month layoff period. During constant hyperventilation, lasting for one hour, more CO_2 was eliminated and the end tidal CO_2 tension was significantly elevated under the first condition. The decreased sensitivity to CO_2 and low O_2 found in skin divers represents an adaptation similar to that observed in diving animals. The changes in lung volumes, consisting of an increase in total lung capacity, vital capacity and tidal volume, and decrease in residual volume, might contribute to the reduced sensitivity to CO_2 because of the relationship found between large tidal volume, small respiratory rate and low response to CO_2 .

Physiological Problems and Hazards Associated With Various Diving and Escape Procedures

Since the clinical problems of diving are discussed by Dr. Bond and air embolism by Dr. Liebow, I only want to mention the physiological problems associated with the hazards of diving.

All divers, whether skin, SCUBA, or deep sea, are subject to the effects of unequalized pressure differences across the air-containing structures, middle ears, sinuses, lungs, and gastro-intestinal tract (barotrauma). The skin diver is safe from air embolism but might develop a thoracic squeeze with pulmonary edema and hemorrhage if he descends to a depth at which the total air in the lung is compressed to a volume smaller than the residual air. To avoid this danger, skin diving should be limited to a 50-foot depth. The SCUBA diver, who can stay under water for a considerable time, is exposed to the same hazards as the conventional diver using helmet and suit: decompression sickness, air embolism, oxygen toxicity and nitrogen narcosis.

Submarine Escape (Free and Buoyant Ascent)

Buoyant ascent (aided by an inflated life jacket) has been successfully carried out from a depth of 300 feet, at an ascent rate of 340 feet/minute, without respiratory distress. Recent evaluation of alveolar gas exchange data, obtained during buoyant ascent from 90 feet has shown that alveolar CO_2

tension can be kept at normal levels at the average ascent rates used.

SCUBA Diving

Several cases of unexplained loss of consciousness occurred with the use of oxygen (closed circuit) diving equipment in which canisters are employed for CO_2 removal. CO_2 intoxication was implicated as the most likely cause of the "shallow water blackout." Using open or closed circuit Self Contained Under Water Breathing Apparatus (SCUBA) units at a greater depth, the direct effect of pressure produces an increased density of the breathing mixture, resulting in an increased breathing resistance. Under these conditions, the work of breathing was found increased in both the breathing apparatus and in the airways of the diver. Pulmonary resistance at four atmospheres pressure increased twofold compared with the values at sea level. Froeb compared the respiratory responses to CO_2 in 16 professional divers using SCUBA equipment with those of nondivers and did not find any evidence of adaptation to CO_2 in the SCUBA divers. In studies of well-trained and less trained under-water swimmers of the U. S. Navy Underwater Demolition Team, using a closed circuit oxygen breathing unit, a higher mean end tidal pCO_2 tension was found in the trained swimmers during swims at a speed of 1.1 to 1.8 km/hr. While resting under water, differences in end tidal pCO_2 were negligible.

Deep Sea Diving

In deep sea diving ("Hard Hat Diving"), in which the conventional suit and helmet are used, a large amount of air has to be ventilated to prevent an accumulation of CO_2 and often this is not fully accomplished. Moreover, at greater depths, breathing resistance becomes very marked and may easily lead to CO_2 retention. Lanphier found that a considerable number of experienced deep sea divers at the U.S.N. Experimental Diving Unit showed CO_2 retention during under water work. The respiratory minute volume declined during work dives to moderate depth using oxygen-nitrogen mixtures. The degree of retention of carbon dioxide was related to the ventilatory response to CO_2 . When breathing resistance was reduced by the use of helium-oxygen mixtures, the CO_2 retention was small or absent.

A more detailed account of the physiological problems involved in diving has been given elsewhere.

Summary

Studies of pulmonary gas exchange during breathhold dives to 90 feet demonstrated the existence of a reversed CO_2 gradient from the lungs into the blood during descent at the 50 foot depth. The influx of CO_2 into the lungs during ascent is regulated by the speed of ascent.

Extremely low alveolar O_2 tensions between 25-35 mm. Hg, found after surfacing from 90-foot dives, emphasize the existing danger of hypoxia. On the basis of these findings it is recommended that skindives should be limited to a 50-foot depth. Observations on metabolic changes during diving and diving bradycardia are discussed.

Adaptation to skin diving consists in: 1) increase in total lung capacity and decrease in residual volume—resulting in an extension of the safe maximum depth; 2) increased tolerance to high CO_2 and low O_2 .

Hazards associated with various diving and escape procedures are discussed.

The 24 references and 2 figures in this paper have been deleted.

FROM THE NOTE BOOK

First Cruise Reenlistment

A review of hospital corpsmen reenlistment statistics for fiscal year 1964 is disappointing, especially those for first cruise personnel. The problem of retaining qualified and trained non-rated personnel is serious. It is imperative that all commands review their reenlistment programs carefully. Pursuit of a vigorous campaign periodically is not the answer. Efforts must be continuous with a specific goal of improvement in the First Cruise Reenlistment rate.

The stability of enlisted personnel desired by our activities, monetary savings, trained future petty officers—all result from concerted efforts in reenlisting worthwhile men. Are incentive programs understood by officer and senior enlisted personnel responsible for providing career guidance and counseling? Are these programs fully explained to all eligible personnel? Are reenlistment interviews, established as basic requirements in BUPERS Instruction 1133.3E, being conducted? The answers to these questions may reveal leadership deficiencies and suggest to the command possible solutions. Accomplishment of an effective reenlistment program must be inspired by a desire of senior personnel to enthusiastically and publicly support a vocation they have elected—a Navy career.

The references listed below are published to recall attention to available reenlistment and career incentives:

BUPERS Instruction 1133.3 (current series)

Subj: Reenlistment Program

BUPERS Instruction 1133.13 (current series)

Subj: Selective Training and Retention (STAR) Program

BUPERS Instruction 1306.73 (current series)

Subj: Duty Assignment Options as Reenlistment Incentive;
promulgation of

BUPERS Instruction 1430.14 (current series)

Subj: Automatic Advancement to Pay Grade E-4 for Certain
Class "A" School Graduates

Enlisted Transfer Manual, NAVPERS 15909, Chapter 12.8
Assignment to School as a Reenlistment Incentive

BUMED Instruction 1510.12 (current series)

Subj: Career Incentives Available for Group X(Medical)
and Group XI (Dental) Ratings

—Hospital Corps Division, BuMed

The Naval Historical Foundation

Founded in 1926, the Naval Historical Foundation is one of the most dedicated and respected historical Foundations. Its membership includes persons in all walks of life, military and civilian. In pursuit of its mission of preserving all that is finest in naval tradition for the generations to come, the Foundation operates the Truxtun-Decatur Naval Museum located at 1610 H Street, N. W., in our nation's capital. Here one can see items from the Foundation's collections that reflect the heritage of our great naval service. From time to time, exhibits are changed to depict various periods or special events in American history. The current series of exhibits covers the Navy's role in the Civil War.

Many documents shown by the Foundation are on long term loan from the Library of Congress where they are available to scholars and researchers. The Foundation is recognized as having the largest available collection of documents and manuscripts on the U. S. Navy. Other projects include an educational historical film, lectures, and publication of items of historical interest.

As is true in any organization of this type, funds are obtained through annual membership dues and contributions. At this time, funds are much needed by the Foundation to assist in the inventory and cataloging of its vast collections. Further information regarding the Foundation and its membership may be obtained by writing to the Naval Historical Foundation, c/o Navy Department, Washington 25, D. C.

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Navy Nurses' Program in Anesthesia

The Navy's Bureau of Medicine and Surgery has announced that its Program in Anesthesia for Nurse Corps Officers was granted full accreditation by the American Association of Nurse Anesthetists in December 1963.

In September 1962, eleven Navy Nurses were admitted to the first class in Anesthesia for Nurse Corps Officers. In order for this program to be effective, it was necessary to meet the requirements of the AANA. Having met the minimum requirements, students will take a national examination in May '64 to qualify as certified registered nurse anesthetists.

One year of didactic work is given at George Washington University and the National Naval Medical Center. The second year of clinical experience in Anesthesia is provided at one of four selected Naval Hospitals where students work under constant supervision. Classroom instruction exceeds the required 250 hours; 500 hours of clinical instruction are available to students in the selected Naval Hospitals.

In August 1963, a committee from National Headquarters of the AANA visited the Naval Medical School, NNMC. Course content and lesson plans were scrutinized, students interviewed, and a lecture attended by members of the inspection team; clinical areas were inspected. Applications are being accepted from members of the Navy Nurse Corps for the third class.

—Nursing Division, BuMed

Navy Nurse Corps Senior Officer Assignments

CDR Florence E. Alwyn NC USN (BS, University of California, San Francisco), Chief Nurse, Headquarters Support Activity, Saigon, South Viet-Nam has been reassigned to USNH Bremerton as Chief of Nursing Service.

CDR Veronica M. Bulshefski NC USN (Hospital of the University of Pennsylvania, Philadelphia; BSNE, Indiana University, Bloomington; MS, Management, U.S. Naval Postgraduate School, Monterey, Calif.), Chief Nurse, USNH Pensacola has been reassigned to USNH Oakland as Chief of Nursing Service.

CDR Lorraine M. Hankey NC USN (St. Barnabas School of Nursing, Minneapolis; BS, University of Washington, Seattle), Chief Nurse USNH Bremerton has been assigned to USNH Pensacola as Chief of Nursing Service.

CDR Grace E. Jacobs NC USN (Springfield Hospital, Springfield, Mass.; BS, Boston University), Chief Nurse, USNH Quantico, Va., has been reassigned to USNH Chelsea as Chief of Nursing Service.

—Nursing Division, BuMed

Radioactivity - A New Publication. National Bureau of Standards Handbook 86; November 29, 1963, 53 pages; 40¢. (Order from Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402.)

Handbook 86 is the latest in a new series of publications presenting the 1962 recommendations of the International Commission on Radiological Units and Measurements (ICRU); the new series will eventually contain six reports. This Handbook deals with radioactivity and presents recommendations of the Commission agreed upon at its meeting in Montreux, Switzerland in April 1962. It contains: (1) direct and relative measurements of the activity of radioactive sources, (2) low-level radioactivity in materials and its relation to radiological measurements, (3) availability of radioactive standards, and (4) technics for measuring radioactivity in samples and living subjects.

Erratum Notice Re: Salary and Rank of Naval Interns. The information contained on page 39 of Vol. 43, No. 1, 3 January 1964 issue of the Navy Medical News Letter was partially in error. Paragraph #5 under Naval Internships (Continued) is corrected to read:

"#5. Under present Navy Promotion policies, naval interns are initially appointed in the rank of Lieutenant. Interns with dependents receive approximately \$8,375 per year; those without dependents receive approximately \$8,074 per year."—Medical Corps Branch, ProfDiv, BuMed

DENTAL**SECTION**The Physician, the Patient, and Statistics

Ernest L. Wynder MD, New York, Division of Preventive Medicine, Sloan-Kettering Institute for Cancer Research. JADA 186(13): 1150.

Man's apparent lack of concern for factors that contribute to disease presents an important challenge to those dedicated to the prevention of disease and the maintenance of health. Both the physician and the patient are faced with this challenge.

Individual clinical or laboratory findings have a relative risk value of incurring a given disease. Those findings with a high risk value may still be relatively small for an individual patient over a short period of time. The difficulty in overcoming this lack of concern is compounded when the finding is asymptomatic. It is at this stage that preventive measures may be effective whereas, once symptoms are observable the disease may be difficult or impossible to cure.

Dr. Wynder uses myocardial infarction as a disease to illustrate the difficulty discussed. As a paraphrase in the field of dentistry, periodontal disease is presented. Of the factors contributing to periodontal disease these are listed: calculus, malocclusion, diet, lack of massage, poor oral hygiene, habits, and general physical condition. All of these factors have a relative bearing on the course of the disease but statistically none can be assigned a rating of 100%. Consequently, how many dentists undertake measures to reduce or eliminate among their patients all of those factors amenable to change? More often than not, patients will return a year later with no clinical symptom present. Consequently, the dentist feels that he acted wisely. However, for the few individuals who do have the asymptomatic clinical finding and subsequently develop the pathology, the dentist must learn not to think in terms of the risk for an individual over a limited period, but in terms of the risk applied to a population for a long time. Similar reasoning must be followed when examining a patient. Thus all available diagnostic aids should be used in examining all tissues.

To continue the paraphrase in another part of Dr. Wynder's paper: The dentist who is aware of statistical chance in the terms just discussed needs to be further trained in the proper method of communication with his patients so that he can express in clear and comprehensible terms what must be done and what may be expected if the advice is not followed. Only to the extent that this can be accomplished can the dentist effectively practice preventive dentistry.

This concept of therapeutic preventive dentistry may be neglected even by dentists specializing in preventive dentistry.

A great challenge faces all practitioners of preventive medicine and dentistry. They must educate their colleagues and the public-at-large in the meaning, interpretation, and application of statistical risk to an individual patient. In the execution of this task lies the very root, if not indeed the whole, of preventive medicine and dentistry. Its full appreciation has a significant influence on the maintenance of health and the preservation of life.

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Pathogenesis of Bacterial Endocarditis*

Alfred A. Angrist and Masamichi Oka. JAMA 183: 249-252, January 26, 1963. From Dental Abstracts 8(12): 719-720, December 1963.

Acute bacterial endocarditis is associated with sepsis and more severe illness and greater stress, in contrast to a subacute bacterial form of the disease with the usual picture of chronic indolent illness.

Based on the authors' observations of heart valves at autopsy and of experimental data, the following concept of endocarditis is offered. Prolonged stress leads to changes in the valve, at least in some instances. Nonbacterial vegetations become the focus for localization of bacteria. Such contamination from the blood stream with the common alpha hemolytic streptococci would be expected in fleeting and passive instances of bacteremia, such as those that follow a tooth extraction or sinus puncture. In instances of sepsis, more virulent microorganisms usually are associated with an active bacteremia. Instances of sepsis are more apt to affect healthy as well as damaged valves; then the interstitial lesion in the valve, the overlying nonbacterial thrombotic endocarditis, and its contamination occur in rapid sequence and merge to become part of the general clinical picture of sepsis. Each form of bacterial endocarditis contributes its particular features to yield the final characteristic pathologic picture and clinical course.

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Dental Sepsis and Lung Infection*

Fallon, Martin and Main, David G. Ashludie Hospital, Dundee, Scotland. Dental Practitioner 13: 281-283, March 1963. From Dental Abstracts 8(12): 722, December 1963.

Dental inspection of a series of 165 patients with pneumonitis (excluding carcinoma, bronchiectasis, and specific infections) revealed that gross dental sepsis was the cause of the lung infection in 51 patients (30%). Nine (25%) of 35 lung abscesses were attributed to dental sepsis.

In most patients the dental sepsis manifested itself as periodontal disease, with or without caries. In 38 of these patients, the sepsis was so gross that all teeth had to be extracted. In 10 patients the sepsis was limited and was dealt with by selective extraction and scaling.

In the 51 patients with lung infection and dental sepsis, there was no source of infection other than that of dental origin. The recoveries which followed dental treatment suggested dental sepsis as the only causative factor. In most of the 51 patients, infection occurred in the typical aspiration sites in the lung; that is, the posterior segment of the upper lobes and the apical segment of the lower lobes.

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Review of Research
on Initiation of Periodontal Disease*

B. Cohen, Royal College of Surgeons, London, England, International Dental Journal 13: 70-79, March 1963. From Dental Abstracts 8(12): 739-740, December 1963.

Theories that periodontal disease originates from a systemic source no longer command the support they once enjoyed. In the past 5 years of periodontal research under review, several investigations have lent support to the view, now widely accepted, that systemic factors, although capable of modifying the reaction of damaged periodontal tissues, cannot reasonably be held to account for the onset of the syndrome. The determining factors in periodontal disease are local in origin and can be aggravated by systemic factors; the predisposing factors are often systemic in origin and act by altering the normal metabolic activities of tissues or by inhibiting their normal reparative capacity (Carranza and Carranza, 1959).

The importance of bacteria in the initiation of periodontal disease has attracted wide attention in recent years. Whether or not the existence of periodontal disease in germ-free mice is accepted, there can be no denying that the disease is modified and doubtlessly aggravated by oral organisms gaining access to the periodontal tissues once pocket formation has commenced. The possible importance of *Bacterioides melaninogenicus* in this respect is suggested by Macdonald (1960).

The World Health Organization Expert Committee (1961) concluded that bacterial plaque is a factor of paramount importance in periodontal disease. Rough surfaces in contact with the gingiva are injurious because they contribute to plaque retention rather than for any mechanical irritation they may inflict.

No one has been able to demonstrate an initial invasion by bacteria of the intact periodontium, but Cohen (1959) suggested that a path of ingress for the toxic products of surface organisms may be established in the course of tooth eruption. Permeability to bacteria also has been ascribed to the lytic effects of certain bacterial metabolites on epithelial cells and to the persistence of vestigial (enamel) epithelium after tooth eruption.

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Personnel and Professional Notes

Leadership in Action. The traditional responsibility for promulgating to the crew internal information which will insure that every man knows what the situation is now, what probably may happen in the future, and what is expected of him relative to each, rests with the Division Officer. The Division Officer concept of personnel management is an old and tested way of accomplishing assigned tasks with optimum efficiency and satisfaction.

At the Naval Dental Clinic, Norfolk, Virginia, the Division Officer concept has been adapted to the principle of personal leadership. This new plan is a departure from the common practice of assigning the Division Officer's responsibility to the Medical Service Corps Officer or to the Warrant Officer on board who, with the scope of his administrative duties, does not have the time to do a thorough job as Division Officer. In this successful new leadership plan, the enlisted personnel are organized in "Divisions" of not more than 12 technicians. Each Division is assigned a junior dental officer as Division Officer. This officer is responsible for continuing personal contact with each man in his Division. To facilitate this personal touch, the Division Officer maintains a notebook containing all pertinent details on each man, such as family size and problems, educational background, ambition, interests, hobbies, disciplinary history, etc. The limited size of each Division facilitates the Division Officer's personal contact with each man, at no interference with the officer's primary duties. This personal recognition supports a sense of belonging in each technician. It stimulates his motivation.

In a leadership organization of this type, the command, the Division Officers and the men realize benefits. The command gains improved efficiency, effectiveness, and morale. Each Division Officer gains experience in the best principles of leadership. Each man gains the dignity and satisfaction of personal recognition-intangible but real factors which stimulate his motivation and, thereby improve his chances for advancement. The principle of this leadership plan is that a person's motivation is stronger when his talents are recognized, when he is encouraged to make full use of his talents, and when his good performance is recognized. This is a positive program which avoids many common pitfalls, e.g., a person's frustration when misplaced, when his talents are wasted or when recognition centers on his mistakes rather his accomplishments. The Division Officer concept of personnel management discussed here is worthy of trial.

AFIP Hosts Postgraduate Course. The Armed Forces Institute of Pathology will host the annual postgraduate course in "Pathology of the Oral Regions," to be held March 2 through March 6, 1964. The course will be directed by CAPT Henry H. Scofield DC USN, Chief of the Dental and Oral Pathology Division, and is designed to provide dentists, physicians and trainees in oral and general pathology a fundamental knowledge of various aspects of oral disease. It will be presented by specialists in the fields of oral and general pathology, oral surgery, periodontics and caries and cancer research. Developmental disturbances of the head, neck and oral region, inflammatory diseases

of the oral mucosa and jaws, the oral manifestations of certain systemic diseases and neoplasms of the oral cavity and related structures will be discussed in detail and their clinical, roentgenographic and microscopic characteristics will be illustrated. Special attention will be directed to current trends in caries research, the role of exfoliative cytology in cancer detection and recent developments in cancer investigation. Lectures will be correlated with case presentations, microscopic seminars and round table discussions.

Leadership Discussion Material. The attention of all dental personnel is directed to BUPERS NOTICE 1910 of 26 December 1963, concerning the gravity of receiving a less than honorable discharge. The message contained therein is poignant material for leadership discussion.

New Schedule for Naval Examining Board. Effective February 1964, the Naval Examining Board will act continuously on applications for regular Navy as they are received in the Dental Division, Bureau of Medicine and Surgery. This is a change from previous practice wherein the Board previously met only semi-annually, in February and August. Candidates may expect to be notified of acceptance or rejection, between four and six weeks after the application has been received by the Dental Division, BUMED.

Navy Dental Corps Presentations at Boston Dental Society. CAPT G. W. Ferguson DC USN, Dental Officer at the U. S. Naval Station, Newport, Rhode Island, presented a talk entitled "Educational and Research Opportunities and Accomplishments of the U. S. Navy Dental Corps" before the North Metropolitan District Dental Society in October 1963 in Boston, Mass. CAPT Howard W. Pierce DC USN, presented a paper covering the subject, "Crown and Bridge Cast Coping Technics." The First Naval District Dental Officer, CAPT W. A. Goldring DC USN, was the program chairman.

CAPT Eastman Clinician at Dental Society Meeting. CAPT Arthur D. Eastman DC USN, the Dental Officer at U. S. Naval Air Station, Whidbey Island, Oak Harbor, Washington was the clinician at the October monthly meeting of the Mount Baker District Dental Society.

Navy Dental Officers Hold New Posts. During recent weeks, the Navy Dental Corps has achieved four measures of recognition by their civilian fellow dentists. RADM Frank M. Kyes DC USN, was elected Vice President of the ADA. CAPT Angus W. Grant DC USN was elected Vice President of the American Academy of Oral Roentgenology. CAPT Victor J. Niiranen DC USN, was elected Vice President of the American Academy of Maxillo-facial Prosthetics. CDR Loren V. Hickey DC USN, was appointed Chairman of the Rubber Dam Committee of the American Academy of Gold Foil Operators. He is also a member of the Literature and Publicity Committees of that organization.

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OCCUPATIONAL MEDICINE

Chemical Health Hazards and Their Control*

Abstracts from Quarterly Occupational Health Reports.

Chlorine. During routine service of a swimming pool chlorinator system, two civil service employees were assigned the task of disconnecting the used chlorine cylinder and replacing it with a new one. The valve on the old cylinder was apparently corroded and was difficult to turn; as a result the cylinder was disconnected from the system before complete closure of the valve was accomplished. The man nearest the discharge end of the cylinder was splashed with liquid chlorine which emerged under pressure from the incompletely shut-off valve. By the time the valve was completely closed, the man suffered a degree of exposure which produced typical symptoms of chlorine inhalation. He was brought to the dispensary where he was given supportive treatment and was then transferred to the naval hospital where he remained under intensive care for two days. He was then symptom free and was discharged to full duty. The other man had much less exposure and did not require hospitalization.

In this incident the men failed to carry out the routine precautions required when servicing chlorinator systems. Canister masks which offer protection against atmospheres containing 2% chlorine were available at the work site. These masks should be worn when piping connections of the chlorine systems are to be opened. The wearing of these masks is mandatory when mechanical difficulties are experienced during work on the chlorinators. (Naval Air Station, Alameda, Calif.)

Sewage Tank Cleaning Procedure; Shipboard. Shipyard personnel were concerned over the health hazards involved when scraping and wire brushing the interior of a tank aboard a MSTS ship. Investigation revealed that the tank is used to collect sewage and waste from sanitary facilities aboard ship before the waste material is pumped overboard. The men were concerned whether disease-producing conditions would be present when the work was done. At the time of the visit the tank was being cleaned by an outside contractor. The cleaning was done by recirculating a caustic solution through the tank and then rinsing with fresh water. The solution used contained three quarters of a pound of caustic soda per gallon and a small amount of detergent. This solution was used at 189°F. for about one hour. Assurance was given to personnel

that no living disease-producer present from the sewage would remain after the above treatment. Precautionary measures were recommended to avoid any health hazard from possible caustic residue which might be dispersed as a dust during the descaling operation. These measures included air-supplied respirators, protective gloves and protective skin creams for exposed skin areas. (Naval Shipyard, New York, N. Y.)

Coal Tar Emulsion Dust, Eye Irritation. An employee reported to the dispensary for treatment of irritation of the eyes. It was learned that he was cleaning surfaces in a tank on a floating crane, prior to the spray painting. It was also learned that the existing dried coating was of the coal tar emulsion type. The irritancy of fresh coatings of the latter as well as its light sensitization reaction on skin and mucous membranes are well known. It is now apparent that this coating retains such irritant properties even after long periods of drying. To prevent further reactions, it was recommended that eye-cup or monogoggles be used for this work. (Naval Shipyard, Charleston, S. C.)

Fiberglass Sandblasting. Within the space of a few days, a number of employees from various shops and trades reported to the dispensary with complaints of severe itching on various parts of the body. Investigation revealed a common space aboard ship in which each employee had worked. It was further learned that sandblasting of old coating in this space was recently completed. It was further learned that plastic sheets, composed of laminated fiberglass impregnated with epoxy resins covered the surfaces of the subject ship space. The sandblasting had created a mixture of the frit and very small particles of fiberglass. The effect of the sandblasting appeared to change the physical condition of the fiberglass to a highly irritating fuzz. It was recommended that any person entering this space be supplied with coveralls which have been carefully taped at the wrists and ankles. (Naval Shipyard, Charleston, S. C.)

Cold Temperatures; Non-Fogging Safety Glasses. Environmental tests of propellants require vibration while stored at extreme temperatures. These may range from a high of 140°F. (desert) to a low of minus 65°F. (arctic). The operators of the environmental chamber are required to enter the chamber to make adjustments and measurements at these extreme temperatures. Arctic type clothing is used when working in the chambers at the low temperatures. However, safety glasses required for eye protection cause difficulties due to fogging. It has been found that a plastic cover goggle intended to fit over prescription glasses does not fog when worn over standard safety glasses. The M-9 gas mask has also been found to be relatively free of fogging troubles, even when passing from ambient temperatures of over 100°F. directly into the test chamber at minus 65°F. (Naval Ordnance Test Station, China Lake, Calif.)

* Submitted by Naval Shore Activities.

Detection of Nonorganic Hearing Loss

Report of Working Group 36. Critical Evaluation of Methods of Testing and Measurement of Nonorganic Hearing Impairment. NAS-NRC Committee on Hearing, Bioacoustics, and Biomechanics, 1963. Pages 7 - 11, November 1963.

A skillful examiner can often detect a nonorganic hearing impairment during the taking of history and physical examination. Further evidence may be gained from routine audiometric tests with pure tones and speech. If nonorganic impairment is suspected, a variety of specialized tests may be administered. The determination of the amount of nonorganic hearing loss is difficult and estimates having reasonable accuracy can be made only under favorable conditions. Few quantitative tests are available.

It is rarely possible to distinguish between subconscious, psychogenic hearing loss and outright malingering. Positive proof of voluntary simulation can be obtained only by inducing the tested person into a frank admission of deceit. Several of the specialized tests may be helpful in encouraging admission of malingering. Because of the difficulty in discriminating between psychogenic hearing loss and malingering, the following classification and evaluation of tests refer to nonorganic hearing loss without regard to its origin. Tests that appear particularly useful for detecting outright malingering are pointed out.

It should be emphasized that none of the available tests is capable of demonstrating absence of nonorganic involvement. They are conclusive only when their outcome is positive.

Procedures for the detection of nonorganic hearing loss may be divided into three broad categories: informal observation, indicator tests, and proof tests. The first two categories overlap with routine auditory examination; the third category aims specifically at the nonorganic hearing loss.

Informal observation. An alert examiner can usually detect the nonorganic origin of hearing loss by noting obvious discrepancies between auditory behavior and test performance. He should observe the patient carefully during the interview and when taking the case history. The attitude of the patient toward his hearing loss can be revealing. The person with a severe organic hearing loss is usually demonstrably worried about it, the person with a nonorganic hearing loss often seems quite unconcerned. Establishment of a suitable motivation is also important. Few, if any, individuals malingering without a motive. Frequently, when the motive is removed, the nonorganic component of hearing loss disappears.

Indicator tests. Several tests in this category belong to routine audiometric examination, i. e., determination of hearing loss for pure tones and speech (Speech Reception Threshold). They rely on the consistency of the listener's responses to test signals. The inexperienced listener with nonorganic hearing loss has difficulty in duplicating his responses on repeated trials, particularly when speech is the test signal. If on repeated trials hearing loss varies by more than 10 decibels (dB), nonorganic hearing loss should be suspected. The chief limitation of this method is that the expert malingerer can duplicate his responses by noting a loudness level well above his threshold and waiting until

this level is reached before responding.

Instead of comparing results of repeated trials, the Speech Reception Threshold (SRT) can be compared to the average hearing loss at 500, 1000, and 2000 cycles per second (cps). In organic hearing loss, both agree to within a few decibels. If the difference exceeds 10 dB, nonorganic hearing loss should be suspected. Under these conditions the measured hearing loss for pure tones is usually higher than for speech, since control of responses by judging loudness is more difficult for speech than for pure tones.

In general, the indicator tests rely on the listeners' conscious decisions with respect to the audibility of test stimuli presented in quiet, i. e., without any interfering sound. Responses involving conscious decisions are known to depend highly on the motivation of the listener. For instance, if the listener's job depends on acute hearing, he will tend to make some responses in the absence of any stimulus. If, on the contrary, he receives compensation for hearing loss, he may tend to respond only when the presence of the stimulus becomes very obvious. It is assumed that individuals with normal hearing or with organic hearing loss are highly motivated to respond to test signals. On this basis intra-test variabilities and inter-test relationships are established. Significant deviations from the expected results indicate a nonorganic impairment. While it is inconceivable that any one individual could master the stimulus-response relationships to a point of being able to conceal the nonorganic origin of his hearing loss if given a sufficiently extensive battery of uncomplicated psychophysical tests, no one test of this category can be considered sufficiently conclusive for a definitive diagnosis.

Proof tests. Proof tests are specifically oriented toward detecting nonorganic hearing loss although some of them may also be used for other purposes. They are usually more complex and more time-consuming than the indicator tests. They should not be administered unless informal observation or at least one of the indicator tests, or both, have led to a suspicion of nonorganic hearing loss. The proof tests can be divided into five subcategories, depending on the basic method involved.

Stimulus interference. It is possible to include in the first category all tests that rely on patients' voluntary responses, but where the test stimulus is presented together with an interfering stimulus. The basic principle involved is the observation that one sound cannot appreciably interfere with the audibility of another sound unless it itself is audible. When the interfering sound becomes effective before it reaches the previously indicated threshold of audibility, it suggests that the threshold has been elevated by nonorganic hearing loss.

When a test of this kind is so designed that the test sound is completely masked out before the interfering sound reaches the threshold indicated by the patient, the test results may provide convincing evidence of nonorganic loss. This is so because the listener loses all information necessary to make decisions correlated with changes in the test sound. The Stenger Test fulfills these requirements. It is based on the principle that a relatively loud sound in one ear makes an identical but fainter sound inaudible in the other

ear. The Stenger Test can produce a quantitative estimate of the nonorganic component of hearing loss. It is probably the most fool proof test against malingering requiring only a two-channel pure-tone or speech audiometer. Unfortunately, its usefulness is limited to strongly asymmetrical hearing losses.

Another test that is based on stimulus interference, although of quite a different nature, is the Swinging Voice Test. In this test, a story is delivered to the listener through earphones in such a way that parts of it reach both earphones; other parts are channelled alternately to each earphone separately. The listener is requested to repeat the story, and his answer depends on whether he heard the story through both or through only one earphone. Like the Stenger, the usefulness of the Swinging Voice Test is limited to asymmetrical hearing losses. Otherwise, it is highly efficient and requires only a two-channel speech audiometer with an appropriate switch.

When the interfering sound does not make the test stimulus completely inaudible but only changes some of its characteristics, a sophisticated listener may obtain sufficient information to conceal the nonorganic origin of his hearing loss. Nevertheless, where such a situation exists, experience with the Doerfler-Stewart Test, has shown that the concealment is extremely difficult. In this test, a saw-tooth noise is made to interfere with speech reception. The signal-to-noise ratio at which speech reception is affected by noise has been determined for listeners with normal hearing and for those with organic hearing loss. Test results that deviate appreciably from the established norms strongly indicate nonorganic hearing loss.

The great advantage of the Doerfler-Stewart Test is that it applies to binaural hearing losses. It requires only a small modification of standard speech audiometers and is not difficult to perform. When skillfully administered, it can be of help in uncovering malingering, and it can produce a quantitative estimate of the nonorganic component.

Auditory motor control. In tests of this subcategory, the listener makes motor responses that are influenced by or are dependent on the auditory feedback. Speaking or reading out loud are typical examples. If the individual can actually hear the sound he produces, and uses auditory clues, his performance can be altered by interference with the auditory feedback. Conversely, a change in performance due to interference with the feedback indicates that the individual can hear the sound. The Lombard Test and the Delayed Feedback Test are typical examples.

In the Lombard Test the tested person is given a text to read out loud. An interfering noise is produced by means of earphones or a loudspeaker, and its intensity is gradually increased. When the noise becomes sufficiently strong to interfere with speech perception, the reader tends to raise his voice. The Lombard Test can be administered monaurally or binaurally and requires only a noise source. Its major shortcoming is a strong susceptibility to learning certain cues, allowing the patient to set a voice level sufficiently invariant so that repetition decreases its efficiency.

The Delayed Feedback Test, known also as Delayed Playback or Delayed

Side Tone Test, is based on a time delay between the patient's speech output and his auditory feedback. When the delayed input is sufficiently strong and is audible to the listener, his speech tends to become loud and distorted. The test has shown considerable promise and is difficult to outmaneuver when done properly. However, it requires special equipment, and there are some individuals on whom the delayed feedback has little effect. In cases of moderate organic loss with nonorganic overlay the test is of limited value because it requires excessively high signal levels.

Reflex responses. In tests of this category, the function of the auditory system is inferred from reflex responses, like eyeblink or change of skin resistance. Since the listener is not asked to make conscious decisions, the psychological factors responsible for nonorganic hearing loss are presumably eliminated, and the reflex threshold may be taken as an indication of normal hearing or organic hearing loss. It should be kept in mind, however, that a reflex response to a sound stimulus can only be taken as evidence that the peripheral end organ and associated neural structures of the brain stem are functioning. It does not necessarily indicate that the sounds that elicit reflex response are also consciously perceived. Reflex responses to sound stimuli have to be conditioned, for instance by a mild electric shock, and several difficulties arise from the conditioning procedure. It is not always possible to elicit the desired reflex even when the stimulus is known to be above the threshold of audibility. A response that is established for strong stimuli may vanish at lower sound intensity levels that are still above the threshold. During prolonged testing, habituation may abolish the reflex but not necessarily if a periodic reinforcement is used rather than a regular schedule. In addition, the use of aversive conditioning stimuli, especially of electric shock, has certain negative psychological effects.

The most widely used test of this category is based on reflexive changes of skin resistance. It is known under the names: Electrodermal Response (EDR), or Psychogalvanic Skin Response (PGSR). The conditioned reflex to tone bursts is elicited by pairing the tones with electric shocks. When the test administrator is experienced and skillful, conditioned responses can usually be maintained during fairly long test sessions. The temporal pattern of resistance changes is plotted by means of a graphic level recorder. Because of spontaneous skin responses, and because the reflex is not always elicited by the same sound signal on repeated presentations, evaluation of the recordings is sometimes difficult. The test requires special equipment and skilled personnel. Under favorable conditions, it can produce quantitative data and serve effectively in detecting nonorganic hearing loss.

The Eyeblink Reflex has not been used routinely because it disappears at near threshold stimulus intensities and is subject to fast habituation.

Electroencephalography. Tests of this category rely on changes in the Electroencephalogram (EEG) that may be produced by sound stimuli. The technique is severely limited by the requirement of elaborate equipment and by the fact that with current methods of recording no specific change in the wave form of the EEG is seen to follow a sound signal. Noticeable changes

occur in whatever wave form is present at the time of auditory stimulation, but they decrease rapidly as the signal approaches threshold intensity as determined by ordinary audiometer tests, and disappear before the threshold is reached. There is some evidence that low level outputs from the cortex can be detected by computers which average EEG responses evoked by sound stimuli. Further experiments must be done before the procedure can be used in clinical tests. In any event, the broad use of the technique is limited by the relatively high cost of the necessary computer equipment.

Narcosis and hypnosis. The use of narcosis or hypnosis in examining patients with suspected nonorganic hearing loss is successful only in the hands of an experienced psychiatrist, and, even then, to a limited degree. These methods are best employed on individuals who have suffered from shock that resulted in a sudden hearing loss. They serve little or no purpose after the hearing loss has lasted for several years. In general, narcosis and hypnosis do not yield as valid or as precise information as do audiological techniques, but this technique has not been systematically investigated.

Although a large number of tests for nonorganic hearing loss are available, no test is foolproof. Quantification of nonorganic hearing loss and differentiation between voluntary malingering and subconscious psychogenic, auditory disorders appear particularly difficult. In each case of suspected nonorganic hearing loss, several methods must be used to substantiate the diagnosis. It is recommended that, after informal examination, one or several indicator tests and at least one proof test be administered.

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Laser-Medical and Industrial Hygiene Controls

H.E. Tebrock MD,* New York, N.Y., W.N. Young MD,** Bayside, N.Y. and W. Machle MD,*** Miami, Fla., Journal of Occupational Medicine, 5 (12); 564-567, December 1963.

Lasers are devices that produce highly parallel, intense beams of light of a single wave length by stimulated emission from various materials. This new technologic development has fired the imagination of research laboratories in the whole scientific community. Research is being performed to use lasers in space communications systems, optical radars and tracking systems, and perhaps even as radiation instruments and weapons. From a communications standpoint they may be used to transmit an extremely large amount of information on many different channels in a vacuum, fiber optic system, or pipe.

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Maiman, in 1960, utilized a ruby rod, the ends of which were polished, optically flat, and parallel. One end of the rod was silvered, the other partially silvered. This ruby consists of .05% chromium oxide in the aluminum oxide crystal. Around this ruby rod, a xenon pumping light excites a number of the chromium atoms to rise to an excited or metastable state. From this higher energy state, the chromium ions drop spontaneously to a lower energy level, each discharging a photon. It is reflected back and forth between the silvered ends of the ruby, and then out from the partially silvered end. This photon emerges at a wave length of 6943 Angstrom units. Many new materials have been discovered which made excellent lasers, including gases such as helium and neon, liquids such as europium chelate in alcohol, and semiconductors such as gallium arsenide for junction lasers. The gas lasers are designed to produce continuous-output beams at many different wave lengths at relatively lower output power than the ruby and neodymium solid-state lasers. Gallium arsenide is intermediate in power output.

From a health or occupational environmental control view point, problems exist in three different areas; those of (1) the much higher powered, pulsed, solid-state lasers; (2) the lower powered, continuous-wave gas laser; and (3) junction diode lasers.

SOLID-STATE LASERS. First, we shall consider the solid-state pulsed laser. If it is the ruby type, the emission will be at 6943 A, and its greatest hazard will be to the retina of the eye. Light incident to the cornea of the eye is focused by cornea and lens to a small point on the retina, causing a resultant concentration many orders of magnitude greater than light incumbent upon the cornea. The lesion produced is probably due to heat, but it appears to differ in many ways from the effect of the typical xenon-powered Zeiss photocoagulators. Because xenon is a high ultraviolet and infrared source it has similar heat qualities, but perhaps the monochromatic laser may also possess ionization or other hazards. However, although both produce an energy effect on the retina similar to an ordinary coagulation or burn of the retina, there have been observations that the pigment is deposited much more quickly in a laser coagulation than in a xenon coagulation (sometimes within 48 hr.). It appears that the principal factor in laser energy absorption by living tissue is pigmentation. Areas of darker pigmentation absorb more light (laser energy) than do areas of lesser pigmentation. Taking advantage of this greater affinity of laser energy for greater pigmented areas, McGuff experimentally utilized laser radiation on human melanomas transplanted onto guinea pig cheek pouches.

Experimental burns of the rabbit retina have been produced by Zaret in chinchilla gray rabbits, as well as in animals with a more deeply pigmented retina. There is a tremendous difference in lesion size and severity, with deeper pigmentation producing the greater severity of reaction. Some hemorrhage occurs from the very center of the chorioretinal burn, but it is generally limited in area and quite small in diameter. Another unusual effect is the sharp, punched-out lesion produced by the laser on the retina. Utilizing a pulsed ruby laser with an output of 0.1 J/sq. cm. in .0005 sec., with a pupil

diameter of 8 mm., a nodal retinal point of 10 mm., and 95% transmissibility of the ocular media, the dose to the retina is 270 J/sq. cm. in .0005 sec. The dose reduced by a factor of 10 still produced a visible lesion, whereas after reduction by a factor of 100 it did not. Therefore, an approximate threshold value for the gray rabbit lies between 6.45 and 0.65 cal./sq. cm.

Campbell has used the laser as a retinal coagulator in retinal tears and detachments in the human. He used an apparatus in which ruby-lased light, aimed with a binocular ophthalmoscope, is reflected through a dichroic mirror directly into the eye. Many coagulations were made with this device in human subjects and at present, in Campbell's hands, it has supplemented the Zeiss photocoagulator in the treatment of human retinal tears. Many fundus photographs have been taken illustrating simultaneous xenonarc retinal lesion and laser lesion (done at the same time in the same eye). Although the methods seem equally effective in producing retinal "welding," many differences are noted in the time appearance of pigment and the nature of the lesion.

Grosoff has made some threshold determinations of eye injury due to ruby energy. Since a rabbit is 3 diopters farsighted, the investigator assumes a 2/10-mm. lesion size on the retina, a 2 1/2% loss at the cornea due to reflectivity, a 97% transmission through the ocular media, and 22% retinal absorption. Using steam as the visible threshold of injury, Grosoff found (in the Belgian hare and chinchilla gray rabbit) 2-14 J/sq. cm. to be the threshold dose. A median figure for all eyes examined resulted in 9 J/sq. cm. as the threshold at the retina. On the other hand, with neodymium lasing at 10,600 Å, 2 1/2 times more power is necessary since only 9% of the energy is absorbed by the retina pigment epithelium. Therefore, 47 J/sq. cm. is the threshold dose at the retina with neodymium.

Ham found that 0.5 cal. at 1 msec. produced a lesion. In 1 sec., 3 cal./sq. cm. were needed to produce a lesion, while at .0001 sec., between 0.1 and 0.2 cal. produced a lesion. He found an average pigment-epithelium absorption of 43%, with a range of 7%-62%; and, also, that ruby had a much higher transmission through the ocular media than neodymium. Solon, on the other hand, feels that .01 cal./sq. cm. might be damaging to the retina. The low-power laser does not appear to damage the skin or other structures of the body in any way unless focused. However, when focused, it would produce burns.

Q switching, Q spoiling, or other high-power ruby and neodymium devices will produce damage to the skin and allied structures with an unfocused beam. The output of these devices is in the range of 100 J or greater. This is achieved by interposing a shutter between the Q cavity and the partially silvered end. A xenon flash lamp is then fired and finally the shutter is opened, allowing one giant but very short pulse out of the partially silvered end. This may be further amplified by passing through another Q cavity of an unsilvered laser system. The lesion produced by the unfocused beam on the skin of the exposed individual appears to be a first-or second-degree burn of varying severity, depending on the amount of pigment epithelium in the skin. Because of the parallel nature of the rays it will be sharply circumscribed and quite

shallow in depth. Microscopic sections of such a lesion show bizarre mitotic figures, which raises the question of carcinoma in situ.

GAS LASERS. The helium-neon gas laser works on a principle slightly different from that of the solid-state lasers. The helium atoms are carried to an excited state by a radio-frequency discharge through the gas-filled tube. Neon atoms initially in the ground state are excited to a metastable state of helium atoms in an excited state. A mirror at one end and a partial mirror at the other end reflect photons back and forth until a discharge occurs through the partially silvered end. The resultant emission of most of these devices is at 6328 Å, and, of course, is continuous wave rather than pulsed. Power outputs so far have been in the mw range with .01 w the average output. From this, one could plot that .01 w incident to the cornea would give a retinal dose of 4.1 w./sq. cm. in a well-lighted room. In a 1-sec. period, this would be 4.1 J/sq. cm. retinal dose or about half the threshold indicated by Grossoff.

GALLIUM ARSENIDE JUNCTION LASER. Another form of laser which has recently become continuous-wave type is a gallium arsenide junction laser. This consists of a gallium arsenide diode with positive and negative regions. In the plane dividing these two regions, photons are emitted by electrons of the negative region, migrating and dropping into holes in the positive region. This emission is around 9000 Å at room temperature but drops to 8400 Å at lower temperatures; hence, it may be rather easily tuned. At present the energy output is in the range of 0.1 w/amp., sufficient to produce a threshold lesion inasmuch, as the energy calculated at the retina is 1330 w./sq. cm. in a well-lighted room. In a 1-sec. period, this would be equivalent to 1330 J/sq. cm., well above the threshold.

SAFE OPERATING LIMITS. The authors' recommendations for control are based on the specific laser energy involved. In the case of the pulsed solid-state laser of modest power (10 J or less), eye shielding is necessary to keep the retina dose below 9 J/sq. cm., provided that the time factor of the pulse remains at or around .0005 sec. If the time factor reaches the .00001-sec. range, a lower allowance at the retina is recommended to allow for the lesser opportunity for heat loss. At the present tenmilliwatt output of the helium-neon gas laser, it does not appear to be a hazard. However, much more work must be done before this is verified. The junction laser, on the other hand, must have attenuation of its beam before entering the eye. This can be accomplished by an antilaser eye shield. High-powered lasers (100 J plus) should not be directed at human skin or other system because of the unknown nature of possible deleterious effects.

Control is really based on one simple cardinal rule-avoidance of the principal beam and its reflection. This can be achieved primarily by fixing the beam on an optical bench, avoiding all reflections of the beam by an appropriately planned diffuse environment. Where the apparatus is portable or

there is a specific attempt to aim at or detect an observer, protection must be provided for the observer. This can be in the form of protective antilaser lenses for the eyes, and clothing over the skin. This antilaser eye shield, at present, must match the wave length of the laser being operated.

For 6943 A (ruby laser), the Bausch & Lomb antilaser eye shield 6000-7000 gives adequate protection for power levels up to 100 J per burst. Obviously, one must not depend upon the glasses alone for protection, but must still follow the cardinal rule of avoidance of the principal beam. Filter glass (B.G. 18), has also been effective as an antilaser eye shield at this wave length. However, the dichroic filter added in the Bausch & Lomb preparation make it preferable, in the writers' estimation. In the 10,600-A range, Bausch & Lomb has a No. 3 welding glass and dichroic filter which give adequate protection. Of great importance is excellent room lighting in order to keep the pupil of the eye as constricted as possible, thereby decreasing the amount of energy impinging on the retina. Along these same lines, the degree of focus or fixation of the eye upon the laser source is also important. If the eye is accommodated for distance the dose of the energy source at the retina will be higher than if accommodated to objects of reference in the room at about the same distance as the laser source.

All skin burns should be carefully followed by regular examinations, because of the unusual microscopic findings found on tissue section after application of the 100-J-per-burst pulse ruby laser. Aside from increasing experimental knowledge, we do not feel excision or biopsy to be warranted.

With respect to persons who may work as engineers or technicians in a laser program, funduscopy photographs should be taken and carefully reviewed to rule out applicants having gross lesions that might later appear to be possible laser burns or complications. In addition, a complete ophthalmological examination (including slit-lamp examination) should be carried out-particularly if the laser will function at wave lengths of 10,600 A or longer. Repeated examinations-at reasonable intervals depending on exposure-should be made, checking any retinal lesions, lenticular opacities, and skin burns. It is also essential to hold spot checks, particularly to uncover changes in the practices of protection.

The principles of controlling environmental laser hazard are as follows:

1. Avoidance of principal beam and its reflection
2. Proper education of personnel involved
3. General information given those who might be casually exposed
4. Use of warning devices to indicate laser in operation
5. Policing and clearing of area for long-range operation
6. Use of proper antilaser eye shields on any observer likely to be exposed
7. Use of count-downs, with persons closing eyes or looking away from pulsed, high-power beam
8. Reporting of all persistent after-images to medical department
9. Funduscopy and slit-lamp examination of all people involved in laser operations

Laser research may well lead to beams of longer and longer wave length as new materials are discovered that satisfy laser requirements. There is also a simultaneous effort to secure increased power output. Since new effects may be noted as the equipment changes, new or additional health and safety requirements must necessarily be formulated to meet the ever changing experiments.

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RESERVE



SECTION

Meeting of the American Mosquito
Control Association

The annual meeting of the American Mosquito Control Association will be held in Chicago, Ill., 1 to 4 March 1964. A Military Section in conjunction with this meeting will be held on the 1, 2, 3, and 4 March 1964. The Bureau of Medicine and Surgery has been advised that the Military Section will be sponsored, supervised, and conducted by the Department of the Army; each session will be at least two hours in duration.

By authority of the Chief of Naval Personnel, one retirement point may be credited to eligible Naval Reserve Medical Department officers in attendance at each session.

* * * * *

ATTENTION: Reserve Nurse Corps Officers on inactive duty

This is an excellent time for you to return to active duty if you are qualified and interested. We have vacancies due to normal attrition and increasing numbers for voluntary retirements. If you hold the rank of Lieutenant Junior Grade or Lieutenant and could complete 20 years of active duty before reaching age 55, you may apply. Application for recall to active duty NavPers 2929 may be obtained at the nearest naval recruiting station.

Sectional Meetings, ACS

A Sectional Meeting of the American College of Surgeons will be held in Denver, Colo., 17 to 19 February 1964. A Military Section in conjunction with this meeting will be held on the 17, 18, and 19 of February 1964. The Bureau of Medicine and Surgery has been advised that the Military Section will be

sponsored, supervised, and conducted by the Department of the Navy; each session will be at least two hours in duration.

By authority of the Chief of Naval Personnel, one retirement point may be credited to eligible Naval Reserve Medical Department officers in attendance at each session.

The Sectional Meeting of the American College of Surgeons will be held in New Orleans, La., 16 to 19 March 1964. A Military Section in conjunction with this meeting will be held on 16, 17, 18, and 19 March. The Bureau of Medicine and Surgery has been advised that the Military Section will be sponsored, supervised, and conducted by the Surgeon General, Department of the Navy; each session will be at least two hours in duration.

By authority of the Chief of Naval Personnel, one retirement point may be credited to eligible Naval Reserve Medical Department officers in attendance at each session.

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Navy Ensign 1915 Medical Program
(continued)

QUESTIONS AND ANSWERS

1. Since participation in the Senior Medical Student Program is considered active duty, will it count as a year for retirement?

Yes, under either the appropriate regular or reserve retirement law.

2. If the 4 years in medical school count for longevity when on active duty, will a Navy intern be in an over 4-year pay grade?

Yes, and in addition, the 4 years in medical school will count as years of satisfactory Federal service providing the student earns at least 50 retirement points per year. He may do so by active participation in the vacation training programs; i. e., research and clinical clerkship training.

3. What are the reasons for rejecting applications from Ensign 1915 officers for the Senior Medical Student Program?

All applications are carefully reviewed by boards both in the Bureau of Naval Personnel and the Bureau of Medicine and Surgery for the purpose of determining the best qualified students. Since candidates for the Senior Medical Student Program must qualify for a commission in the regular Navy, qualifications are therefore more severely considered. Some applicants are rejected because of physical disabilities, others are rejected

because of low academic records and reports which indicate that the individual is not otherwise best suited for military service.

4. What are the chances of being assigned sea duty during the 2 or 3 years obligated service?

At the present time the chances are that 1 out of every 6 individuals serving during their 2 or 3 years obligated service are assigned aboard ships at sea. Tours of sea duty range from 12 to 24 months.

5. On completion of internship, may a request for a desired duty station be made?

Yes. An opportunity is afforded to indicate 4 types of duty desired. These preferences will be considered in the ultimate assignment of duty station.

(To be continued)

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